Storm Water Engineering

Development Community Workshop
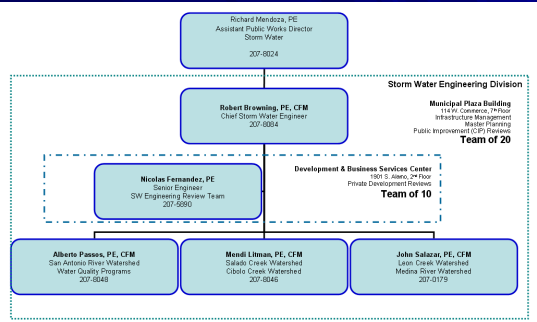
June 25, 2009
Presented at the
May 2009 Bexar County Consultant Workshops
by the Storm Water Engineering Division
of the San Antonio Public Works Department

Topics

- Welcome / Introductions
- UDC Amendments
- Allowable Detention Design Methods
- Modified Rational Method Workshop

June 25, 2009   2

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Water Quality Programs	Cibolo Creek Watershed	Medina River Watershed
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June 25, 2009   3

2009 UDC REVISIONS + UPCOMING RIDs

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Topics

- Amendments Adopted January 09
- Amendments Ready for Council Action
- Current Challenges / Upcoming RIDs
- Questions

June 25, 2009   5

Effective 1/25/09
35-504(b) (1) B. – RSWMP Participation

(b) Stormwater **Storm Water Management Program**

   (1) **Regional** Storm Water **Management Program (RSWMP).**

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     B. Options available to All developers to shall participate in the RSWMP include in one of three ways:

      1. Payment of a fee in lieu of on-site detention (except in areas designated by the Director of Public Works as "Mandatory Detention Areas"). The fee schedule is included in Appendix "C"-109.

      2. Construction of on-site or off-site measures (typically storm water detention facilities) to mitigate increases in runoff resulting from the proposed development. a RSWF to mitigate an existing flooding problem.

      3. Construction or participation in the construction of a an off-site RSWF to mitigate increased stormwater storm water runoff anticipated by from ultimate development of the watershed.

June 25, 2009   6

Slide 1

Effective 1/25/09

35-504(b) (1) C.1.- Adverse Impact / Small Lot Policy

C.   To determine a significant adverse impact for the purposes of this section, the following criteria will be used to analyze the receiving stormwater storm water facility facilities within for two thousand (2,000) linear feet downstream of the project, or to the nearest downstream RSWF, or to the nearest floodplain with an ultimate analysis accepted by the City, whichever is less. (The 2000 linear feet is based on an estimate that this length will approximate a one hundred acre drainage area. The one hundred-acre drainage area represents the lower limit for a 100-year frequency stormwater facility design.) For lots less than three acres in size, adverse impact analyses need only extend to where tributary drainage areas equal 100 Acres.

1.   The design stormwaterstorm water surface elevation (DSE WSE) in the receiving stormwater facility [natural or improved] drainage systems within 2000 linear feet of the proposed development may not be increased by the proposed development within the 2000 linear feet from the development unless the increased DSE WSE is contained within an easement or right-of-way   easements or rights of way or the receiving facility has systems have sufficient capacity to contain the increased DSE WSE without increasing flooding to a habitable structure structures.

June 25, 2009

7

Slide 2

Effective 1/25/09

35-504(b) (1) C. 3.- Deletion of SARA facility analysis

3.   Where a development is upstream of an existing San Antonio River Authority (SARA) flood control facility or other detention facility constructed prior to 2000, analyses will be provided to insure that capacity exists within the facility to accommodate the increased runoff from the proposed development.

June 25, 2009

8

Slide 3

Effective 1/25/09

35-504(b) (1) C. 3. – Adverse Impact Criterion moved

(2)   **System Criteria.**

A. All stormwater management facilities, or combination of facilities, shall be designed for ultimate development. Facilities with drainage areas under 100 acres shall be designed for a 25-year storm. Facilities with drainage areas over 100 acres or areas within a FEMA designated floodplain shall be designed for a 100 year storm or a 25 year storm plus B. freeboard (based on Table 504-9) if that elevation is higher. Detention facilities and streets are exceptions to the frequency C. criteria cited above. Detention facility outflows will be designed for 5-year, 25-year and 100-year frequency storms. Refer to   § 35-504(g) for specific drainage design criteria for streets.

C. Three development conditions shall be analyzed for each development.

1. Existing Conditions: This refers to current development conditions in the watershed and on site. Use as the baseline analysis for determining the impact of development.

2. Proposed Conditions: This refers to existing conditions with the proposed development added. Use to determine if the increased runoff from the proposed development results in an adverse impact to other properties.

3. Ultimate Conditions: This refers to ultimate development conditions within the watershed used to design the drainage facilities. This condition may be used in lieu of subsection 2, above, to determine if the increased runoff from the ultimate watershed development results in an adverse impact to other properties.

June 25, 2009

9

3

Effective 1/25/09
35-504(b) (1) C. 3. – Adverse Impact Criterion moved

3. Three Development conditions shall be analyzed with each adverse impact analysis.

Existing Conditions.

This refers to current development conditions in the watershed and on site. This shall be used as the baseline for determining the impact of the development of the site, or the watershed, to other properties or drainage systems.

Proposed Conditions.

This refers to existing conditions with the proposed development added. This shall be used to determine if the increased runoff from the proposed development results in an adverse impact to other properties or drainage systems.

Ultimate Conditions.

This refers to ultimate development conditions within the watershed. In addition to being used to design proposed drainage facilities (subsection "(2) System Criteria", below), this condition shall also be used to determine if the increased runoff from the ultimate development of the watershed results in an adverse impact to other properties or drainage systems.
In addition to verifying low water crossing capacity (item 2, above), this analysis shall be used to assist the city in identifying watershed wide storm water management issues.
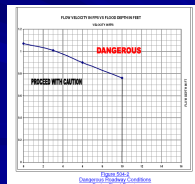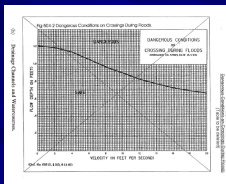
June 25, 2009
10

Effective 1/25/09
35-504(b) (1) C. 4.- Dangerous to Cross graph

4. Minimum standards for identifying Dangerous Roadway conditions are identified in figure 504-2.

Note: The City of San Antonio contends that any runoff crossing a roadway creates a potentially dangerous condition. Figure 504-2 represents the maximum flow over roadways that the City will accept in adverse impact analyses signed and sealed by the licensed professional engineers.

Figure 504-2
Dangerous Roadway Conditions
During Flood Events

June 25, 2009
11

Effective 1/25/09
35-504 (d) (6) – Interceptor Easements

(6)   **Interceptor Easements.**

A. Drainage easements for proper conveyance of upstream storm water runoff shall be required on all subdivision plats where upstream contributing area exceeds the criteria indicated below. Interceptor drains shall be constructed prior to the issuing of building permits on any lot that would be affected by natural drainage being intercepted.
   1. Interceptor drainage easements and channels shall be provided for residential subdivisions where the drainage area to the back of platted lots exceeds the depth of two average residential lots with equivalent zoning. Interceptor drains shall be constructed prior to the issuing of building permits on any lot that would be affected by natural drainage being intercepted.

   2. Interceptor drainage easements shall be required on non-residential subdivision plats where the off-site drainage area contributing to the proposed development exceeds 3 acres. If necessary, an amending plat may be used to correct drainage easements in conjunction with building permits.

June 25, 2009
12

4

Slide 13

Effective 1/25/09
35-504 (g) (8) – Unflooded Access

(8) Unflooded Access

A. During an ultimate development 5-year storm event unflooded access (within the "Proceed with Caution" range per figure 504-2) shall be available to proposed new developments. This unflooded access shall extend to the next arterial street not adjacent to the development or to a distance of one quarter mile, whichever is less.

B. The Director of Public Works may waive this requirement for developments under three acres (3 Ac) in size.

June 25, 2009   13

Slide 14

Effective 1/25/09
35-504 (g) (8) – Regional Storm Water Fees

35-C109   Regional stormwater **Storm Water** Management **Program** Fees

The following fees are established as fee-in-lieu of providing detention for participation in the regional storm water management program of the City of San Antonio. When approved by the director director of public public works (requirements are defined in section 35-504) the fees must be paid before a subdivision plat is recorded or a building permit is released.

(A) Development Type	(B) Minimum Fees
Detached single-family and two-family duplex residential developments	$ 1,200 per participating acre or $750 per lot, whichever is less
Residential development other than single-family or two-family	$ 1,600 per participating acre
Nonresidential with less than 65% impervious cover (e.g. schools, churches, parks)	$ 2,600 per participating acre
Nonresidential with impervious cover of 65 % or greater (e.g. commercial development)	$ 3,000 per participating acre

Development Type refers to the maximum possible development allowed by the current zoning. Development Type for "Unzoned" parcels (e.g. in the City Extra Territorial Jurisdiction, or 'ETJ') shall be based on the current development patterns.

Development Types for public rights of way shall be equivalent the adjacent development type(s). Where development types are different from one side of the right of way to the other, each development type shall be assumed to extend to the centerline of the right of way.

Acreage of participation shall be the entire area of the platted property less any areas specifically designated by restricting easement as being "pervious" and restricted from placement of impervious cover.

RSWMP Fees shall be paid at EITHER the platting stage OR at the building permit stage. Any RSWMP fees not previously collected (e.g. fees for properties platted prior to the 1997 RSWMP creation, the remaining balance when fees were previously paid based on less adverse development types or were paid based solely on impervious cover, etc.)

June 25, 2009   14

Slide 15

Effective 1/25/09
35-F Section B – 3 ft depth / 3 ft per second

35-F 125   Section B - Prohibited Development Within the Regulatory Floodplain

(a)   The following development will not be allowed in the regulatory floodplain.

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(5)   100-year floodplain reclamation where the watershed drainage area exceeds 100 320 acres, except as provided in Section A.

(6)   100-year floodplain reclamation in over bank areas that are subject to flood depths greater than 3 feet.

(7)   100-year floodplain reclamation in over bank areas where flood velocities are greater than 3 fps.

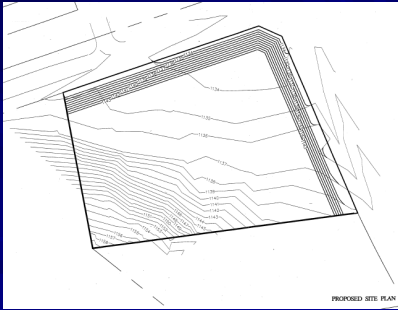June 25, 2009   15

Slide 16:

Ready for Council Action
35-F Section A – Floodplain Storage Volume Loss

35-F124   Section A - Allowable Development Within the Regulatory Floodplain

* * * * *

(d)   Account for increase in discharge due to loss of storage and increase in impervious cover in all reclamation analysis.

* * * * *

(f)   The following development may be allowed in the Regulatory 100-year Floodplain and will require a Floodplain Development Permit (See 35-B106 for permit requirements).

(1)   All-weather (passes the ultimate development 100-year flood) street crossings that passes the ultimate development 100-year flood under the street.

* * * * *

(20)   100-year floodplain reclamation in areas of ineffective flow where floodplain storage volume lost to reclamation is offset by comparable excavation within the same creek floodplain. (See 35-F124 (d) and 35-124 (f) (27))

(21)   100-year floodplain reclamation in overbank areas subject to extensive shallow (0'-3') flooding where flood velocities in the overbank area are less than 3 fps and where floodplain storage volume lost to reclamation is offset by comparable excavation within the same creek floodplain. (See 35-F124 (d) and 35-124 (f) (27))

June 25, 2009   16

Slide 17:

Ready for Council Action
35-F Section A – Floodplain Storage Volume Loss

(27)   Construction in areas of flood inundation must meet the requirements of section 35-F141, General Standards. Structures associated with park and recreation development (fences, open construction type bleachers, concession stands etc.) may be permitted in areas of flood inundation. Keep this construction out of the flood conveyance section of the floodplain. Compensate for loss of storage. Secure structures to minimize damage from hydrostatic or hydrodynamic forces (including buoyancy) and debris impact.

* * * * *

June 25, 2009   17

Slide 18:

Ready for Council Action
35-F Section A – Floodplain Storage Volume Loss

June 25, 2009   18

Slide 19

Ready for Council Action

35-F Section A – Floodplain Storage Volume Loss

PROPOSED SITE PLAN

Slide 20

Ready for Council Action

35-504(b) (1) C. 2.- Dangerous LWC Conditions

Slide 21

Ready for Council Action

35-504(b) (1) C. 2.- Dangerous LWC Conditions

Ready for Council Action
35-504 (f) (4) – Detention Deferral

(4) **Easement Requirements.**

A. Drainage easements will be ~~provided~~ required for all ~~regional~~ detention facilities ~~and water quality ponds~~ accepting runoff from properties other than the lot on which the detention pond exists or will be constructed. Maintenance of the detention facility shall be the responsibility of the property owner or the property owner's association.

B. Full detention basin design may be deferred until the building permit stage IF the property owner submits a "request for detention deferral" demonstrating an understanding of the implications of such design deferral AND the following notes are placed on the subdivision plat AND supporting documentation is provided.
1. "Storm Water detention is required for this property. The engineer of record for this subdivision plat has estimated that an area of approximately _____ acres and a volume of approximately _____ acre feet will be required for this use. This is an estimate only and detailed analysis may reveal different requirements."
2. "No building permit shall be issued for this platted property until a storm water detention system design has been approved by the City of San Antonio."

Current Challenges / Upcoming RIDs

- RSWMP Fees for minimal IC increases
- Unflooded Access
- Detention Pond Design Methods

Acceptable Runoff Equations / Detention Design Methods

Presented by

by Robert Browning, PE, CFM

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Runoff Calculations

- Rational Method
  - 0 to 320 Acres
  - i.e. Q = ciA
  - (Per UDC <u>required</u> below 640 Acres)
- SCS CN (TR55) Hydrograph Method
  - 10 Acres and above
  - (Per UDC <u>required</u> above 640 Acres)

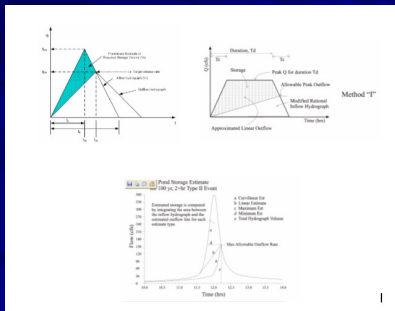June 25, 2009   25

Detention Storage Estimation

- Detention Deferral
- Rational Method
  - 0 to 3 Acres
- Modified Rational Method
  - 0 to 320 Acres
- SCS / Hydrograph "Curvilinear Estimate"
  - 10 Acres or More

June 25, 2009   26

Current Challenges / Upcoming RIDs

June 25, 2009   27
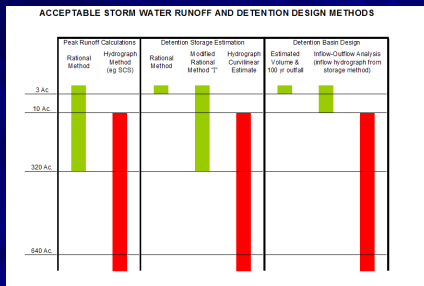
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Detention Design

- Rational Method
  - 0 to 3 Acres
  - IF L.I.D. Type Feature
    - i.e. not allowed with underground storage
  - Outfall structure calculation OR routing
- Modified Rational Method
  - 0 to 10 Acres
  - Inflow / Outflow Analysis Required
- SCS "Curvilinear Estimate"

28

Current Challenges / Upcoming RIDs

ACCEPTABLE STORM WATER RUNOFF AND DETENTION DESIGN METHODS

29

The Modified Rational Method

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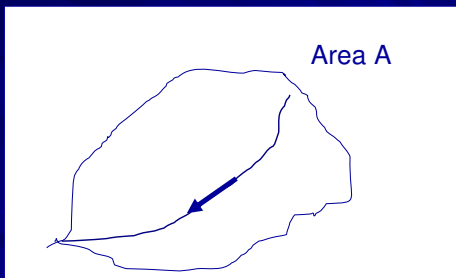The Rational Method

$$Q_P = c.i.A$$

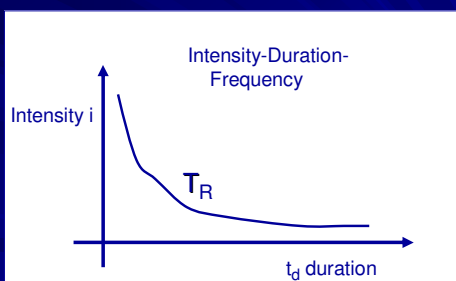- Assumptions

- Applicability

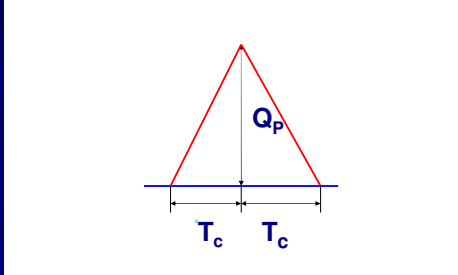Rational Method
Tributary Area

Area A

Rational Method
Intensity

Intensity-Duration-
Frequency
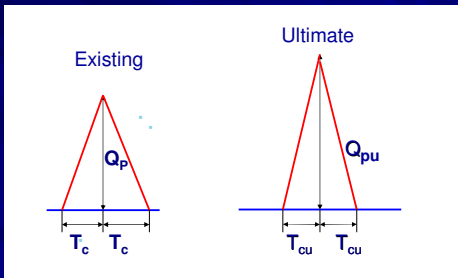
Intensity i

T_R

t_d duration

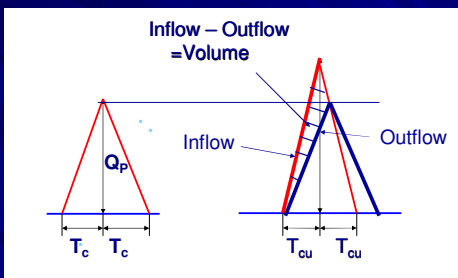Synthetic Hydrograph
one simple format for this

Synthetic Hydrographs
Existing and Ultimate

Synthetic Hydrographs
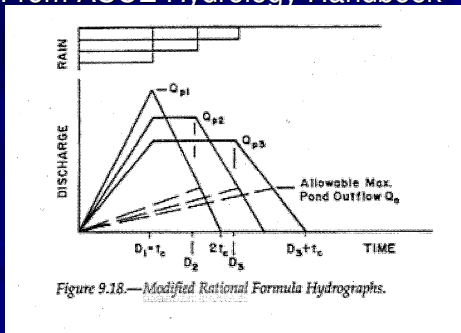Estimate detention volume with triangular hydrographs

Modified Rational Method

- To generate a more conservative / accurate synthetic inflow hydrograph

- To provide a preliminary estimate for detention pond volume requirements

37

Modified Rational Method
From ASCE Hydrology Handbook

Figure 9.18.—*Modified Rational Formula Hydrographs.*

38

Modified Rational Method
Intensity and Qp Recalculation

Intensity-Duration-Frequency

Intensity i

T_R

Recalculate

$Q_P = C.i_n.A$

39

13
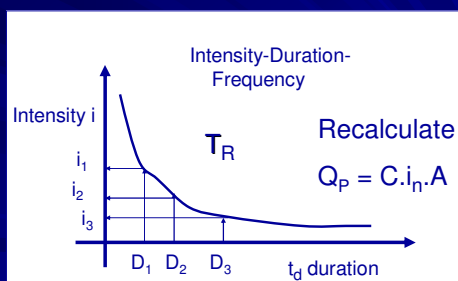
Modified Rational Method

- Trial and Error method calculating the volume for different duration times; until volume is maximized
- At every step volume recalculated with the following formula

$$V_p = Q_p \cdot D - Q_o\left[\frac{D + t_c}{2}\right]$$

June 25, 2009   40

Modified Rational Method Sample Calculation

A=5.61 acres, C = 0.61, Qex,5yr = 10.2 cfs, Tc = 23 min, Tr = 5 yr

	Tc	Td	I (in/hr)	Q (cfs)	Det. Pond V (CY)
5	23	23	4.3	13.64747	176.2039711
5	23	25.3	4.12	13.07618	187.7718753
5	23	27.6	3.93	12.47315	191.5533165
5	23	31.05	3.69	11.71143	195.5221896
5	23	34.5	3.46	10.98145	190.244638
5	23	39.1	3.22	10.21973	184.1812104
5	23	46	2.88	9.14063	152.375552
5	23	57.5	2.565	8.140874	127.8894492
5	23	62.1	2.47	7.83936	117.3650271

June 25, 2009   41

Modified Rational Method Sample Calculation

A=5.61 acres, C = 0.61, Qex,100yr = 10.2 cfs, Tc = 23 min, Tr = 100 yr

Tr	Tc	Td	I (in/hr)	Q (cfs)	Det. Pond V (CY)
100	23	23	6.78	21.51857	263.6601116
100	23	25.3	6.55	20.78859	290.7938632
100	23	27.6	6.36	20.18556	318.2520508
100	23	31.05	6.05	19.20167	342.4064446
100	23	34.5	5.74	18.21778	351.4745664
100	23	39.1	5.39	17.10694	357.5633304
100	23	41.4	5.23	16.59913	356.4711539
100	23	46	4.93	15.64698	345.2025942
100	23	57.5	4.35	13.80616	300.8093972
100	23	62.1	4.2	13.33009	292.6229791

June 25, 2009   42

Storm Water Engineering

Development Community Workshop

QUESTIONS ??